



24 m is from about 1 to about 2;  
25 o is from about 1 to about 2; and,  
26 X is selected from the group consisting of fluorine, oxygen, sulfur, and  
27 chlorine.

1 2. The method of claim 1 wherein X is fluorine.

1 3. The method of claim 1 wherein X is sulfur.

1 4. The method of claim 1 wherein X is chlorine.

1 5. The method of claim 1 wherein said final coefficient of friction is  
2 about 0.3 or less.

1 6. The method of claim 1 wherein said final coefficient of friction is  
2 about 0.2 or less.

1 7. The method of claim 1 wherein said final coefficient of friction is  
2 about 0.1 or less.

1 8. The method of claim 1 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1 9. The method of claim 1 wherein said sufficient quantity comprises  
2 about 25 atomic % X in relation to chromium content.

1 10. The method of claim 2 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1 11. The method of claim 2 wherein said sufficient quantity comprises  
2 about 25 atomic % X in relation to chromium content.

1 12. The method of claim 3 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % X in relation to chromium content.

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1           13.    The method of claim 3 wherein said sufficient quantity comprises  
2   about 25 atomic % X in relation to chromium content.

1           14.    The method of claim 4 wherein said sufficient quantity comprises  
2   from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           15.    The method of claim 4 wherein said sufficient quantity comprises  
2   about 25 atomic % X in relation to chromium content.

1           16.    The method of claim 1 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           17.    The method of claim 2 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           18.    The method of claim 3 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           19.    The method of claim 4 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           20.    The method of claim 5 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           21.    The method of claim 6 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

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1           22.     The method of claim 7 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           23.     The method of claim 16 wherein said final hardness is about 15 GPa or  
2 more.

1           24.     The method of claim 16 wherein said final hardness is about 20 GPa or  
2 more.

1           25.     The method of claim 16 wherein said final hardness is about 25 GPa or  
2 more.

1           26.     The method of claim 17 wherein said final hardness is about 15 GPa or  
2 more.

1           27.     The method of claim 17 wherein said final hardness is about 20 GPa or  
2 more.

1           28.     The method of claim 17 wherein said final hardness is about 25 GPa or  
2 more.

1           29.     The method of claim 18 wherein said final hardness is about 15 GPa or  
2 more.

1           30.     The method of claim 18 wherein said final hardness is about 20 GPa or  
2 more.

1           31.     The method of claim 18 wherein said final hardness is about 25 GPa or  
2 more.

1           32.     The method of claim 19 wherein said final hardness is about 15 GPa or  
2 more.

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- 1 33. The method of claim 19 wherein said final hardness is about 20 GPa or  
2 more.
- 1 34. The method of claim 19 wherein said final hardness is about 25 GPa or  
2 more.
- 1 35. The method of claim 20 wherein said final hardness is about 15 GPa or  
2 more.
- 1 36. The method of claim 20 wherein said final hardness is about 20 GPa or  
2 more.
- 1 37. The method of claim 20 wherein said final hardness is about 25 GPa or  
2 more.
- 1 38. The method of claim 21 wherein said final hardness is about 15 GPa or  
2 more.
- 1 39. The method of claim 21 wherein said final hardness is about 20 GPa or  
2 more.
- 1 40. The method of claim 21 wherein said final hardness is about 25 GPa or  
2 more.
- 1 41. The method of claim 22 wherein said final hardness is about 15 GPa or  
2 more.
- 1 42. The method of claim 22 wherein said final hardness is about 20 GPa or  
2 more.
- 1 43. The method of claim 22 wherein said final hardness is about 25 GPa or  
2 more.
- 1 44. The method of claim 2 wherein said final coefficient of friction is  
2 about 0.3 or less.

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1           45.     The method of claim 2 wherein said final coefficient of friction is  
2     about 0.2 or less.

1           46.     The method of claim 2 wherein said final coefficient of friction is  
2     about 0.1 or less.

1           47.     The method of claim 2 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           48.     The method of claim 2 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           49.     The method of claim 29 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           50.     The method of claim 29 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           51.     The method of claim 30 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % substituent in relation to chromium  
3     content.

1           52.     The method of claim 30 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           53.     The method of claim 31 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           54.     The method of claim 31 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           55.     The method of claim 44 wherein said surface comprises an initial  
2     hardness and said conditions are effective to produce a final hardness that is greater  
3     than said initial hardness.

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1           56.    The method of claim 45 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           57.    The method of claim 46 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           58.    The method of claim 55 wherein said final hardness is about 15 GPa or  
2 more.

1           59.    The method of claim 55 wherein said final hardness is about 20 GPa or  
2 more.

1           60.    The method of claim 55 wherein said final hardness is about 25 GPa or  
2 more.

1           61.    The method of claim 56 wherein said final hardness is about 15 GPa or  
2 more.

1           62.    The method of claim 56 wherein said final hardness is about 20 GPa or  
2 more.

1           63.    The method of claim 56 wherein said final hardness is about 25 GPa or  
2 more.

1           64.    The method of claim 57 wherein said final hardness is about 15 GPa or  
2 more.

1           65.    The method of claim 57 wherein said final hardness is about 20 GPa or  
2 more.

1           66.    The method of claim 57 wherein said final hardness is about 25 GPa or  
2 more.

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1           67.     The method of claim 3 wherein said final coefficient of friction is  
2     about 0.3 or less.

1           68.     The method of claim 3 wherein said final coefficient of friction is  
2     about 0.2 or less.

1           69.     The method of claim 3 wherein said final coefficient of friction is  
2     about 0.1 or less.

1           70.     The method of claim 3 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           71.     The method of claim 3 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           72.     The method of claim 41 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           73.     The method of claim 41 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           74.     The method of claim 42 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           75.     The method of claim 42 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

1           76.     The method of claim 43 wherein said sufficient quantity comprises  
2     from about 10 atomic % to about 40 atomic % X in relation to chromium content.

1           77.     The method of claim 43 wherein said sufficient quantity comprises  
2     about 25 atomic % X in relation to chromium content.

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1           78.     The method of claim 67 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           79.     The method of claim 68 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           80.     The method of claim 69 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           81.     The method of claim 78 wherein said final hardness is about 15 GPa or  
2 more.

1           82.     The method of claim 78 wherein said final hardness is about 20 GPa or  
2 more.

1           83.     The method of claim 78 wherein said final hardness is about 25 GPa or  
2 more.

1           84.     The method of claim 79 wherein said final hardness is about 15 GPa or  
2 more.

1           85.     The method of claim 79 wherein said final hardness is about 20 GPa or  
2 more.

1           86.     The method of claim 79 wherein said final hardness is about 25 GPa or  
2 more.

1           87.     The method of claim 80 wherein said final hardness is about 15 GPa or  
2 more.

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1           88.    The method of claim 81 wherein said final hardness is about 20 GPa or  
2   more.

1           89.    The method of claim 81 wherein said final hardness is about 25 GPa or  
2   more.

1           90.    A method of forming a lubricious outer surface comprising chromium,  
2   said method comprising:

3           providing a substrate comprising a surface comprising chromium, said surface

4                   having an initial coefficient of friction in an unlubricated condition

5                   against a steel counterface;

6           treating said surface with an additive comprising oxygen under conditions

7                   effective to produce a mixture comprising chromium-oxide molecules

8                   and substrate molecules adjacent to said lubricious outer surface

9                   consisting essentially of oxide molecules comprising chromium oxide;

10          wherein said lubricious outer surface has a final coefficient of friction in an

11                   unlubricated condition against a steel counterface that is less than said

12                   initial coefficient of friction.

1           91.    The method of claim 90 wherein said final coefficient of friction of  
2   said surface is about 0.3 or less.

1           92.    The method of claim 90 wherein said final coefficient of friction of  
2   said surface is about 0.2 or less.

1           93.    The method of claim 90 wherein said final coefficient of friction of  
2   said surface is about 0.1 or less.

1           94. The method of claim 90 wherein said additive is selected from the group  
2 consisting of carbon monoxide, carbon dioxide, formic acid, methyl alcohol, ethyl  
3 alcohol, and acetone.

1           95. The method of claim 90 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % substituent in relation to chromium  
3 content.

1           96. The method of claim 90 wherein said sufficient quantity comprises  
2 about 25 atomic % substituent in relation to chromium content.

1           97. The method of claim 91 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % substituent in relation to chromium  
3 content.

1           98. The method of claim 91 wherein said sufficient quantity comprises  
2 about 25 atomic % substituent in relation to chromium content.

1           99. The method of claim 92 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % substituent in relation to chromium  
3 content.

1           100. The method of claim 92 wherein said sufficient quantity comprises  
2 about 25 atomic % substituent in relation to chromium content.

1           101. The method of claim 93 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % substituent in relation to chromium  
3 content.

1           102. The method of claim 94 wherein said sufficient quantity comprises  
2 about 25 atomic % substituent in relation to chromium content.

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1           103.    The method of claim 94 wherein said sufficient quantity comprises  
2   from about 10 atomic % to about 40 atomic % substituent in relation to chromium  
3   content.

1           104.    The method of claim 90 wherein said sufficient quantity comprises  
2   about 25 atomic % substituent in relation to chromium content.

1           105.    The method of claim 90 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           106.    The method of claim 91 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           107.    The method of claim 92 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           108.    The method of claim 93 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           109.    The method of claim 94 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           110.    The method of claim 105 wherein said final hardness is about 15 GPa  
2   or more.

1           111.    The method of claim 105 wherein said final hardness is about 20 GPa  
2   or more.

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- 1           112.   The method of claim 105 wherein said final hardness is about 25 GPa  
2   or more.
- 1           113.   The method of claim 106 wherein said final hardness is about 15 GPa  
2   or more.
- 1           114.   The method of claim 106 wherein said final hardness is about 20 GPa  
2   or more.
- 1           115.   The method of claim 106 wherein said final hardness is about 25 GPa  
2   or more.
- 1           116.   The method of claim 107 wherein said final hardness is about 15 GPa  
2   or more.
- 1           117.   The method of claim 107 wherein said final hardness is about 20 GPa  
2   or more.
- 1           118.   The method of claim 107 wherein said final hardness is about 25 GPa  
2   or more.
- 1           119.   The method of claim 108 wherein said final hardness is about 15 GPa  
2   or more.
- 1           120.   The method of claim 108 wherein said final hardness is about 20 GPa  
2   or more.
- 1           121.   The method of claim 108 wherein said final hardness is about 25 GPa  
2   or more.
- 1           122.   The method of claim 109 wherein said final hardness is about 15 GPa  
2   or more.
- 1           123.   The method of claim 109 wherein said final hardness is about 20 GPa  
2   or more.

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1           124.   The method of claim 109 wherein said final hardness is about 25 GPa  
2   or more.

1           125.   A method of forming a hard surface comprising chromium, said  
2   method comprising:  
3           providing a substrate comprising chromium comprising a surface having an  
4           initial hardness;  
5           treating said surface with an additive comprising an element selected from the  
6           group consisting of oxygen, carbon, and a combination thereof under  
7           conditions effective to produce a final surface having a final hardness  
8           greater than said initial hardness, said final surface comprising a  
9           mixture comprising substrate molecules and molecules selected from  
10          the group consisting of chromium oxide, chromium carbide, and a  
11          combination thereof, said mixture being adjacent to an outer surface  
12          consisting essentially of oxides comprising chromium oxide.

1           126.   The method of claim 125 wherein said additive is selected from the  
2   group consisting of carbon monoxide, carbon dioxide, formic acid, methyl alcohol,  
3   ethyl alcohol, and acetone.

1           127.   The method of claim 125 wherein said additive is selected from the  
2   group consisting of carbon monoxide ions and carbon dioxide ions.

1           128.   The method of claim 125 wherein said additive is carbon monoxide  
2   ions.

1           129.   The method of claim 125 wherein said final hardness is about 15 GPa  
2   or more.

- 1           130.   The method of claim 125 wherein said final hardness is about 20 GPa  
2   or more.
- 1           131.   The method of claim 125 wherein said final hardness is about 25 GPa  
2   or more.
- 1           132.   The method of claim 126 wherein said final hardness is about 15 GPa  
2   or more.
- 1           133.   The method of claim 126 wherein said final hardness is about 20 GPa  
2   or more.
- 1           134.   The method of claim 126 wherein said final hardness is about 25 GPa  
2   or more.
- 1           135.   The method of claim 127 wherein said final hardness is about 15 GPa  
2   or more.
- 1           136.   The method of claim 127 wherein said final hardness is about 20 GPa  
2   or more.
- 1           137.   The method of claim 127 wherein said final hardness is about 25 GPa  
2   or more.
- 1           138.   The method of claim 128 wherein said final hardness is about 15 GPa  
2   or more.
- 1           139.   The method of claim 128 wherein said final hardness is about 20 GPa  
2   or more.
- 1           140.   The method of claim 128 wherein said final hardness is about 25 GPa  
2   or more.
- 1           141.   A method for making a medical implant comprising:

2 providing a component of a medical implant comprising a substrate  
3 comprising a surface comprising chromium, said surface having an  
4 initial coefficient of friction in an unlubricated condition against a steel  
5 counterface;  
6 treating said surface with an additive comprising oxygen under conditions  
7 effective to produce a mixture comprising substrate molecules and  
8 chromium-oxide molecules adjacent to a lubricious outer surface  
9 consisting essentially of oxide molecules comprising chromium oxide,  
10 said surface having a final coefficient of friction in an unlubricated  
11 condition against a steel counterface that is less than said initial  
12 coefficient of friction.

1 142. The method of claim 141 wherein said final coefficient of friction of  
2 said surface is about 0.3 or less.

1 143. The method of claim 141 wherein said final coefficient of friction of  
2 said surface is about 0.2 or less.

1 144. The method of claim 141 wherein said final coefficient of friction of  
2 said surface is about 0.1 or less.

1 145. The method of claim 141 wherein said sufficient quantity comprises  
2 from about 10 atomic % to about 40 atomic % oxygen in relation to chromium  
3 content.

1 146. The method of claim 141 wherein said sufficient quantity comprises  
2 about 25 atomic % oxygen in relation to chromium content.

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1           147.    The method of claim 142 wherein said sufficient quantity comprises  
2   from about 10 atomic % to about 40 atomic % oxygen in relation to chromium  
3   content.

1           148.    The method of claim 142 wherein said sufficient quantity comprises  
2   about 25 atomic % oxygen in relation to chromium content.

1           149.    The method of claim 143 wherein said sufficient quantity comprises  
2   from about 10 atomic % to about 40 atomic % oxygen in relation to chromium  
3   content.

1           150.    The method of claim 143 wherein said sufficient quantity comprises  
2   about 25 atomic % oxygen in relation to chromium content.

1           151.    The method of claim 144 wherein said sufficient quantity comprises  
2   from about 10 atomic % to about 40 atomic % oxygen in relation to chromium  
3   content.

1           152.    The method of claim 144 wherein said sufficient quantity comprises  
2   about 25 atomic % oxygen in relation to chromium content.

1           153.    The method of claim 141 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           154.    The method of claim 142 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           155.    The method of claim 143 wherein said surface comprises an initial  
2   hardness and said conditions are effective to produce a final hardness that is greater  
3   than said initial hardness.

1           156. The method of claim 144 wherein said surface comprises an initial  
2 hardness and said conditions are effective to produce a final hardness that is greater  
3 than said initial hardness.

1           157. The method of claim 141 wherein said final hardness is about 15 GPa  
2 or more.

1           158. The method of claim 141 wherein said final hardness is about 20 GPa  
2 or more.

1           159. The method of claim 141 wherein said final hardness is about 25 GPa  
2 or more.

1           160. The method of claim 142 wherein said final hardness is about 15 GPa  
2 or more.

1           161. The method of claim 142 wherein said final hardness is about 20 GPa  
2 or more.

1           162. The method of claim 142 wherein said final hardness is about 25 GPa  
2 or more.

1           163. The method of claim 143 wherein said final hardness is about 15 GPa  
2 or more.

1           164. The method of claim 143 wherein said final hardness is about 20 GPa  
2 or more.

1           165. The method of claim 143 wherein said final hardness is about 25 GPa  
2 or more.

1           166. The method of claim 144 wherein said final hardness is about 15 GPa  
2 or more.

1           167.   The method of claim 144 wherein said final hardness is about 20 GPa  
2   or more.

1           168.   The method of claim 144 wherein said final hardness is about 25 GPa  
2   or more.

1           169.   A substrate comprising chromium and a gradient from an inside to an  
2   outside surface consisting essentially of:

3           substrate molecules/a mixture of said substrate molecules and substrate-X  
4           molecules comprising chromium-X/a surface comprising a sufficient  
5           quantity of said chromium-X molecules to produce a final coefficient  
6           of friction in an unlubricated condition against a steel counterface that  
7           is less than a virgin coefficient of friction of said surface in the absence  
8           of said gradient;

9           wherein X is selected from the group consisting of fluorine, oxygen, sulfur,  
10          and chlorine.

1           170.   The substrate of claim 169 wherein X is fluorine.

1           171.   The substrate of claim 169 wherein X is sulfur.

1           172.   The substrate of claim 169 wherein said gradient further comprises  
2   chromium carbide molecules.

1           173.   The substrate of claim 170 wherein said gradient further comprises  
2   chromium carbide molecules.

1           174.   The substrate of claim 171 wherein said gradient further comprises  
2   chromium carbide molecules.

1           175.   A chromium coating comprising a gradient from inside to an outside  
2   surface consisting essentially of:

1           180. The method of claim 174 wherein said chromium coating comprises in  
2 initial hardness, and said means for reducing said initial coefficient of friction further  
3 comprises means for increasing said initial hardness.

1           181. A chromium coating comprising  
2 a surface comprising chromium oxide having an initial coefficient of friction  
3 in an unlubricated condition against a steel counterface; and  
4 means for reducing said initial coefficient of friction.

1           182. The chromium coating of claim 176 further comprising in initial  
2 hardness, said means for reducing said initial coefficient of friction further comprising  
3 means for increasing said initial hardness.

1           183. A chromium alloy substrate comprising  
2 a surface comprising chromium oxide having an initial coefficient of friction  
3 in an unlubricated condition against a steel counterface; and  
4 means for reducing said initial coefficient of friction.

1           184. The chromium alloy substrate of claim 178 further comprising in initial  
2 hardness, said means for reducing said initial coefficient of friction further comprising  
3 means for increasing said initial hardness.

1           185. A method of forming a hard chromium coating comprising:  
2 providing a chromium coating having an initial hardness; and  
3 means for increasing said initial hardness.

1           186. The method of claim 180 wherein said means for reducing said initial  
2 hardness further comprises means for decreasing said initial coefficient of friction.

1           187. A chromium coating comprising  
2 a surface comprising chromium oxide having an initial hardness; and

3 means for increasing said initial hardness.

1 188. The chromium coating of claim 187 wherein said means for reducing  
2 said initial hardness further comprises means for decreasing said initial coefficient of  
3 friction.

1 189. A substrate comprising a chromium coating comprising:  
2 a gradient consisting essentially of primarily chromium/a mixture of  
3 chromium-X molecules and chromium molecules/a surface comprising  
4 a sufficient quantity of said chromium-X molecules to produce a final  
5 coefficient of friction in an unlubricated condition against a steel  
6 counterface that is less than a virgin coefficient of friction of said  
7 surface in the absence of said gradient;

8 X being selected from the group consisting of fluorine, oxygen, sulfur, and  
9 chlorine.

1 190. The substrate of claim 189 wherein X is fluorine.

1 191. The substrate of claim 189 wherein X is sulfur.

1 192. A substrate comprising a chromium coating comprising a gradient  
2 from inside to an outside surface consisting essentially of:

3 primarily chromium molecules/a mixture of chromium oxide molecules and  
4 chromium molecules/a surface comprising a sufficient quantity of said  
5 chromium oxide molecules to produce a final coefficient of friction in  
6 an unlubricated condition against a steel counterface that is less than a  
7 virgin coefficient of friction of said surface in the absence of said  
8 gradient.

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1            193.    The substrate of claim 192 wherein said gradient further comprises  
2 chromium carbide molecules.

1            194.    The substrate of claim 192 comprising an automotive component.

1            195. The substrate of claim 192 comprising an aeronautical component.

1        196.    The substrate of claim 192 comprising a journal bearing.

1            197.    The substrate of claim 192 comprising a tool for injection molding of  
2    filled polymers.

1           198.   The substrate of claim 192 wherein said tool is selected from the group  
2   consisting of a plated mold and a runner block.

1           199.   A medical implant comprising a gradient from inside to an outside  
2   surface consisting essentially of:

chromium alloy molecules/a mixture comprising chromium alloy molecules  
and chromium oxide molecules/a surface comprising a sufficient  
quantity of said chromium oxide molecules to produce a final  
coefficient of friction in an unlubricated condition against a steel  
counterface that is less than a virgin coefficient of friction of said  
surface in the absence of said gradient.

1           200.    The medical implant of claim 199 wherein said gradient further  
2 comprises chromium carbide molecules.

1        201.    The medical implant of claim 199 comprising a total joint replacement.

1            202.    The medical implant of claim 200 comprising a total joint replacement.

1           203.    A medical implant comprising a gradient from inside to an outside  
2    surface consisting essentially of:

3 a surface comprising chromium oxide having an initial coefficient of friction  
4 in an unlubricated condition against a steel counterface; and  
5 means for reducing said initial coefficient of friction.

1 204. The medical implant of claim 169 further comprising means for  
2 increasing an initial hardness of said surface.

1 205. The medical implant of claim 202 comprising a total joint replacement.

1 206. The medical implant of claim 203 comprising a total joint replacement.

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